JOURNAL OF TRAFFIC AND TRANSPORTATION ENGINEERING (ENGLISH EDITION) 2015; 2 (5): 327–337

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Original Research Paper

Distracted walking: Examining the extent to pedestrian safety problems

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ARTICLE INFO

Article history:
Available online 7 August 2015

Keywords:
Distracted walking
Pedestrian distractions
Public awareness campaigns
Walking safety rules/tips
Pedestrian fatalities
Traffic fatalities

ABSTRACT

Pedestrians, much like drivers, have always been engaged in multi-tasking like using hand-held devices, listening to music, snacking, or reading while walking. The effects are similar to those experienced by distracted drivers. However, distracted walking has not received similar policies and effective interventions as distracted driving to improve pedestrian safety. This study reviewed the state-of-practice on policies, campaigns, available data, identified research needs, and opportunities pertaining to distracted walking. A comprehensive review of literature revealed that some of the agencies/organizations disseminate useful information about certain distracting activities that pedestrians should avoid while walking to improve their safety. Various walking safety rules/tips have been given, such as not wearing headphones or talking on a cell phone while crossing a street, keeping the volume down, hanging up the phone while walking, being aware of traffic, and avoiding distractions like walking with texting. The majority of the past observational-based and experimental-based studies reviewed in this study on distracted walking is in agreement that there is a positive correlation between distraction and unsafe walking behavior. However, limitations of the existing crash data suggest that distracted walking may not be a severe threat to the public health. Current pedestrian crash data provide insufficient information for researchers to examine the extent to which distracted walking causes and/or contributes to actual pedestrian safety problems.

1. Introduction

Walking is one of the active transport modes with many public health benefits and precedes all other transportation modes. It helps with reducing greenhouse gas emissions, which is responsible for global warming, climate change, and poor air quality. Walking can also help relieve traffic related congestion problems. Like other modes of transportation, interactions between pedestrians and vehicles on the same

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Peer review under responsibility of Periodical Offices of Chang'an University.
http://dx.doi.org/10.1016/j.jtte.2015.08.004

roadway create safety concerns. Pedestrian fatalities accounted for 11% of the U.S. total traffic fatalities in 2003 and 14% in 2012 (NHTSA, 2014a). Fig. 1 shows the trend of total fatalities and pedestrian fatalities resulting from traffic crashes from 2003 to 2012 extracted from traffic safety facts 2012 data (NHTSA, 2014a). The figure shows that on average, pedestrian fatalities steadily decreased from 2004 to 2009 and gradually increased from 2009 to 2012. In 2012, almost 73% of pedestrian fatalities occurred in an urban setting versus a rural setting (NHTSA, 2014a).

According to 2009 National Household Travel Survey (NHTS), walking trips accounted for 10.9% of all trips reported in the survey (FHWA, 2010). Factors contributing to pedestrians' fatalities include environment, infrastructure, and human factors (Sarkar et al., 2011). Factors cited in the literature that significantly contribute to fatal and non-fatal pedestrian crashes include improper crossing of a roadway, inattentiveness, and failure to obey traffic signs. These unsafe behaviors have been shown to account for 28%, 15%, and 3% of pedestrian deaths (Bungum et al., 2005). In addition, factors of pedestrians crash types also included pedestrians walking along the roadway, failing to yield, crossing the roadway, crossing highway and darting/dashing midblock (HSIS, 2011).

Pedestrians, much like drivers, have always engaged in multi-tasking like using hand-held devices, listening to music, snacking, or reading that draw their attention while walking. The effects of distracted walking are similar to those experienced in distracted driving (Sarkar et al., 2011; Nasar et al., 2008; Hyman Jr. et al., 2010). Market penetration of electronic devices among walkers and drivers is on the rise and so are safety issues related to distracted walking. For example, The Wireless Association reported that in December 2012, about 171.3 billion text messages were sent in the U.S. (includes Puerto Rico, Guam, and the U.S. Virgin Islands) every month (CTIA, 2013). Similarly, they reported that wireless penetration—e.g. the number of active units divided by the total U.S. and territorial population (Puerto Rico, Guam, and the U.S. Virgin Islands) was 102.2%. In addition, the focus on livable communities or health and fitness programs may increase walking and pedestrian-vehicle conflicts and if pedestrians or motorists are distracted, the potential for crashes increases (Hedlund, 2010). However, distracted walking has not received similar interventions and policies to curb its impacts on pedestrian safety.

Although distracted walking problems are imminent threats to safety, few or even no data are collected for research and quantification of distracted walking. A report prepared for Governors Highway Safety Association reported that several states noted crash reports or anecdotal evidence of pedestrian crashes in which distraction was a factor (Hedlund, 2010). In recent years, researchers have investigated the impact of distracted walking on pedestrian safety. Additionally, in the wake of distracted walking problems, agencies within the nation and abroad have taken measures to improve the safety of distracted walkers. However, no compilation of such efforts exists which would enable practitioners to share experiences. Furthermore, this study was unable to find sufficient and accurate data currently available for evaluating distracted walking problems. While distracted pedestrian literature is growing, this study aimed to review the state-of-practice on policies, programs, data sources for current studies, and identified data collection opportunities and research needs pertaining to distracted walking.

2. Research studies on pedestrian distractions

This study conducted comprehensive searches of the literature on distracted walking. The main focus of the review was to determine the contributing factors to distracted walking. The findings of these studies are crucial in revealing the safety hazards associated with distracted walking and effective countermeasures for improving safety. The studies are classified as observational-based, survey-based, crash-based and experimental-based with the majority of the studies being experimental. A concise explanation on methods and major findings from each study is provided on the following sub-sections.

2.1. *Experimental-based studies*

Hyman et al. (2010) observed and compared the walking behavior of people conversing on a cell phone with individuals walking alone with no electronics, individuals walking and listening to a music player, and individuals walking in pairs. The study found that individuals walking while talking on a cell phone displayed inattentional

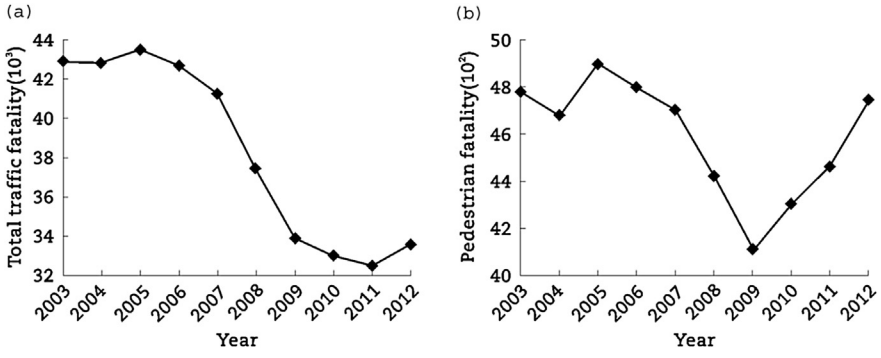

Fig. 1 – Total traffic fatalities and pedestrian fatalities in traffic crashes from 2003 to 2012. (a) Total traffic fatality. (b) Pedestrian fatality.

blindness. Consequently, about 75% of the cell phone users failed to notice unusual activity compared to over half of the people in the other testing conditions who reported noticing unusual activity. Schwebel et al. (2012) used a semi-immersive virtual pedestrian street to investigate the influence of conversing on phone, texting, and listening to music on pedestrian safety. Participants distracted by music or texting were more likely to be hit by a vehicle in the virtual pedestrian environment than the undistracted participants, and no behavioral differences were observed between male and female participants. Neider et al. (2010) used an immersive virtual environment to investigate the effect of divided attention while crossing a busy street. The study considered three scenarios, namely, undistracted, engaged in a hands-free cell phone conversation, and listening to music on an iPod. Pedestrians conversing on the phone were less likely to cross the road successfully compared to those listening to music. In another study, Neider et al. (2011) examined dual-task costs in older and younger adults using a simulated street crossing task constructed in an immersive virtual environment with an integrated treadmill. Participants were asked to cross the simulated streets of varying difficulty while either undistracted, listening to music, or conversing on a cell phone. Older adults were more vulnerable to dual-task impairments than younger adults when the crossing task was difficult. Authors suggested that the difference in dual-task impairments could be due to cognitive planning processes. Kuzel et al. (2008a) investigated the effect of using cellular phone while walking on pedestrian's ability to visually perceive and gather details about objects in their environment. Volunteers were instructed to walk through an office hallway and report on their perception and the details of 11 out-of-place salient objects placed at eye and ground level while being normally attentive, being on a casual cell phone conversation, and a challenging cell phone conversation. The study found that cell phone use can considerably alter pedestrian's capability to notice and collect features of objects. Byington and Schwebel (2013) examined whether young adult pedestrian safety was compromised while crossing a virtual pedestrian street while distracted by usage of mobile internet. Participants crossed a virtual pedestrian street 20 times, half the time while undistracted and half while completing an email-driven "scavenger hunt" and answered mundane questions using internet on their cell phones. It was concluded that pedestrian behavior was considerably riskier when distracted with mobile internet than when they were undistracted.

2.2. *Survey-based studies*

In April 2013, Liberty Mutual Insurance (2013) conducted a countrywide phone survey of 1004 adults ranging in age between 18 and 65 years. It was found that 3 in 5 (60%) use smartphones while crossing the street. Breaking down by activity, of all respondents 51% indicated talk on the phone, 26% text or email, and 34% listened to music while crossing the street. Further, the study found that out of 1004 respondents, 55%, 26%, and 25% considered texting or emailing, talking on the phone, and listening to music while crossing a street as most dangerous activities, respectively. In addition, when comparing these results to distracted driving survey studies, 70% talked on the cell phone, 64% listened to music at a high volume, and 38% read or sent text messages while walking.

2.3. *Observational-based studies*

Bungum et al. (2005) assessed the relationship between distracted walking and performing routine cautionary behaviors of pedestrians crossing a busy street in a southwestern city at an intersection adjacent a university. Trained observers recorded behaviors of 866 pedestrians as they walked across a 105-foot wide street served by a stop light and a zebra-painted crosswalk. The study found that 5.7% of the observed pedestrians crossed the street while wearing headphones or conversing on the phone, and 15.1% were eating, drinking, or smoking while in the crosswalk. Thompson et al. (2013) found that 29.8% of 1102 observed pedestrians displayed a distracted activity such as talking on the phone, texting, or listening to music. The study by Nasar et al. (2008) indicated that while crossing a crosswalk, 19.0% of the pedestrians were using a mobile phone, 24.2% used an iPod, and 55% didn't use either one. In general, observational studies examining the effect of cell phone use on street-crossing behavior have found that the pedestrians cross more slowly when conversing on a cell phone, are less likely to look at traffic before entering the roadway, and make more unsafe crossings compared to non-distracted pedestrians (Bungum et al., 2005; Nasar et al., 2008; Hatfield and Murphy, 2007). Walker et al. (2012) observed cautionary behavior (looking before crossing a road) for pedestrians with or without personal music devices (PMDs). The study found that male pedestrians listening to PMDs, displayed more looking behavior than those not listening to PMDs, while females showed no differences between the two conditions. Authors concluded that unlike cell phones, PMDs do not decrease cautionary behavior of pedestrians.

2.4. *Crash-based studies*

The literature review revealed two studies that investigated distracted walking using crash data. Kuzel et al. (2008b) reviewed real-world collisions involving pedestrians who were reportedly auditorily distracted. The review found that highly salient and expected roadway objects such as buses, police vehicles, and trains have been involved in collisions with reportedly distracted pedestrians at or near standardized road crossing points. The data suggested that pedestrians distracted by auditory activities, regardless of their form, may not always be sufficiently engaged in the act of crossing or walking along a street to perform the task safely. Lichenstein et al. (2012) searched the National Electronic Injury Surveillance System, U.S. Consumer Product Safety Commission, Google News Archives and Westlaw Campus Research Databases for cases involving pedestrian distraction from 2004 to 2011. The study found 116 reports of death or injury of pedestrians wearing headphones. Of all the reports, 74% stated that the

pedestrian was wearing headphones at the time of the crash and 29% mentioned that a warning was sounded before the crash. The majority of victims were male (68%) and under the age of 30 years (67%). The majority of vehicles involved in the crashes were trains (55%), and 89% of cases occurred in urban counties. Nasar and Troyer (2013) used data from the U.S. Consumer Product Safety Commission on injuries in hospital emergency rooms from 2004 to 2010 to evaluate pedestrians' mobile phone related injuries. The study found that pedestrian injuries that related to mobile-phone usage while walking increased compared to total pedestrian injuries in 2010. Mobile-phone use related injuries for pedestrian under 31 years old were higher for males than female. It was concluded that using a mobile phone while walking puts pedestrians at risk of accident, injury or death.

3. Availability of data on distracted walking

As mobile devices continue to dominate the telecommunications market, incidences of distracted walking problems will likely continue to escalate. Thus, it is essential to identify data availability for conducting research on safety evaluation of distracted pedestrians. Data would enable quantification of distracted walking problems and provide concrete evidence on the extent that pedestrians are affected by distractions. As shown in Table 1, most of the current studies rely on experimental-based data. Though useful, the controlled environment of experimental studies may hinder generalization of study findings as they do not represent the general walking population and real-time walking environments. Similar to experimental-based studies, simulation-based studies also suffer from unrealistic pedestrian environments, for example, one study (Kuzel et al., 2008a) had pedestrians complete complex math problems while walking. This would rarely happen in a real walking environment and, therefore, the results of the study are not necessarily reflective of real distracted walking behaviors.

The literature search revealed only two crash-based studies existed. Though newspapers have reported vehicles hitting and killing pedestrians who were talking or manipulating mobile devices (Sridharan and Parrino, 2005; Zeller Jr., 2007), this information was not shown on crash reports (Hedlund, 2010). In addition, Nasar et al. (2008a) indicated the need for better data on pedestrian–auto accidents to establish if the use of electronic mobile devices among pedestrians results in increased risk of accidents. Based on current studies, observational-based studies and the survey-based study are based on relatively larger datasets compared to other studies. However, there is a need for more survey and observational data to increase geographical coverage.

In summary, major findings on studies that evaluated distracted pedestrian walking safety related problems are as follows.

- Pedestrians noticed significantly more objects while not engaged in conversation.
- Results suggested that engaging in an auditorily distractive activity can cause pedestrians to miss salient objects in their environment.
- Studies indicated that pedestrians who are auditorily distracted while crossing an intersection appear to exhibit unsafe behavior (failure to look right and left, wait on curb for light to turn green before stepping into the street).

4. Current practices to reduce distracted walking

In order to bring enlightenment on existing endeavors to restrict distracted walking, we organized broad widespread searches to ascertain citation information, public awareness programs, organizational safety information, and legislations that concentrate on distracted walking. Numerous safe walking organizations' websites functioned as the fundamental sources for material associated with safety walking tips and rules for pedestrians. A broad research of state, city and country legislations led to information on distracted walking bills and various policies that were implemented to curb distracted walking. A typical web search of “distracted walking” as the keyword generated several websites and articles that provided information on legislature, educational awareness, safety rules resources, and technological items for distracted walking. As anticipated, considering the recent phenomena of distracted walking, there was scant technology and material that addressed distracting walking. The attempts to reduce distracted walking are classified into enforcement, public awareness programs, education programs, and legislative actions.

4.1. *Enforcement information*

In 2012, the city of Fort Lee in New Jersey implemented a policy that permits city police to hand an $85 fine to pedestrians crossing mid-block. Prior to issuing tickets, pamphlets were handed out to warn people, and a month later 117 tickets were handed out (Lowy, 2013; Divon, 2013). In March 2012, the Utah Transit Authority (UTA) adopted an ordinance that prohibited pedestrians from distractions including talking on cell phones, listening to music with headphones, texting, attending to personal hygiene or reading newspapers or magazines while crossing the UTA rail tracks on the streets of Salt Lake City. Distracted walkers are subject to a $50 civic fine and repeated offenses could cost $100. Efforts to make it a statewide law failed in July 2012. Further, UTA officials reported that the ordinance was working and that pedestrians were doing it the right way more often (Cortez, 2012; Davidson, 2012).

4.2. *Public awareness campaigns*

This study examined various organizational websites for cities, states and countries to identify whether they have implemented public awareness campaigns/programs for distracted walking. The listing in this study is very extensive as it relates to the content, but not as exhaustive due to the fact that a multitude of organizations have started to develop public awareness programs. These campaigns employed several different tactics to alert pedestrians about the dangers

Table 1 – Safety walking rules/tips.

No.	Country	Agency/organization	Title	Actual wording
1	United States	Pedestrian and Bicycle Information Center Walking safely (http://www.pedbikeinfo.org)	Safety tips for pedestrians	Don't wear headphones or talk on a cell phone while crossing.
2	United States	Walking Safety Rules (http://walking.about.com/od/beginners/a/safewalkingrule.htm)	Walking safety rules	Keep the Volume Down: Don't drown out your environment with your iPod. Keep the volume at a level where you can still hear bike bells and warnings from other walkers and runners. Your audiologist will also thank you. Hang Up and Walk: Chatting on a cell phone while you walk is as dangerous as chatting while driving. You are distracted and not as aware of your environment. You are less likely to recognize traffic danger, passing joggers and bikers or tripping hazards. Potential criminals see you as a distracted easy target.
3	United States	National Highway Transportation Safety Administration (NHTSA)	Safe walking tips for youth	Be aware of traffic. Don't be distracted by using electronics.
4	United States (Partners with organizations in 23 other countries)	Safe Kids World Wide (http://www.safekids.org/sites/default/files/documents/ResearchReports/Walking-Safely-Research-Report.pdf)	Walking safely: a report to the nation	Each of us must commit to walking and driving without distraction. Distraction due to mobile technologies is an epidemic resulting in both deaths and injuries and must end.
5	Canada	Alberta Urban Municipalities Association and Alberta Municipal Services Corporation (http://www.auma.ca/live/MuniLink/Communications/Member+Notices?contentId=14259)	Growing danger for drivers: distracted walkers	Avoid distractions like texting and cell phone use. Use crosswalks and intersections—never jaywalk. Cross with care. Make eye contact with drivers and wait until traffic has stopped before you cross.
6	United States	Everybody Walk	Walk and don't talk: pedestrians distracted by mobile phones	Public safety attention to the dangers of being distracted by mobile phones, not just for those in a car but for those getting around on their own two feet as well.
7	United States	Office of Compliance (http://www.compliance.gov/wp-content/uploads/2010/06/Walking-Hazards-April-2010-Fast-Fact.pdf)	The hazards of using mobile devices while walking	Don't walk, talk and text. If you have to talk or text, move to the side of the walkway out of the way of others. Never cross or walk in the street while using an electronic device. Do not walk with headphones in your ears. Keep track of your surroundings.
8	Canada	Canada Safety Council	Watch where you're walking	Look up from phones and other electronic devices when crossing the street, and turn the volume down on headphones.

(*continued on next page*)

Table 1 – (continued)

No.	Country	Agency/organization	Title	Actual wording
9	United States	Children's Safety Network (http://www.childrenssafetynetwork.org/blog/dangers-distracted-walking-talking-children-about-pedestrian-safety)	Dangers of distracted walking: talking to children about pedestrian safety	Here are some guidelines to discuss with children about safe cell-phone usage: Keep it out of reach. Keep the phone in a backpack on silent to eliminate temptation to use the phone while walking. Stop the walk to talk. If you do need to make a call or send a text, stop walking and stand out of the way of traffic until you are finished. Listen up. Keep the volume of music low enough to hear passing traffic or turn off music while walking. Spread the word. Help raise awareness about the issue by talking to friends about the dangers of distracted walking.

of distracted walking for different locations, which are discussed in detail in the following sections.

4.2.1. *Philadelphia*

In April 2012, the Philadelphia Mayor's Office played a practical fool's day joke to raise awareness on distracted walking. The officials marked the "E-Lane" (Electronic Device Lane), a designated sidewalk space for use by distracted pedestrians on the 1400 block of JFK Boulevard as shown in Fig. 2. Though the joke, officials reported that people were compliant and thought it was helpful that officials were now drafting an education campaign for distracted walking (Cortez, 2012).

4.2.2. *Delaware*

In May 2012, Delaware highway safety officials placed decals that read "Look up. Drivers aren't always looking out for you" on crosswalks and sidewalks at busy intersections. Another decal depicting drunk pedestrians and pedestrians using electronic devices read "Don't join the walking dead" at a non-crosswalk. These decals were placed in bus interior ads, bus exterior ads, shelter ads, and distributed to pedestrians. This was implemented as part of the "walk smart" campaign that aimed at educating pedestrians on safe walking practices (Cortez, 2012). A sample decal is shown in Fig. 3.

4.2.3. *San Francisco Municipal Transportation Agency*

In 2008, the San Francisco Municipal Transportation Agency (SFMTA) introduced a multimedia campaign composed of outdoor ads, radio and television spots that reminded people that "headsets and handheld devices could be a distraction". One sign, which asked, "Do you want Beethoven to be the last thing you hear?" is shown in Fig. 4 (SFMTA Municipal Transportation Agency, 2013). In May 2013, police officers and Abraham Lincoln High School students handed out small cards with warnings about pedestrian safety across San Francisco's parkside neighborhood. The cards contained information that warned residents of the dangers of distracted walking (McMenamin, 2013).

A review of the Muni's (San Francisco Municipal Railway) riders guide revealed that in station riders are advised to avoid using their cell phone, texting or other multitasking while walking as shown in Fig. 4. In addition to the campaign, drivers of municipal buses, trains, and maintenance vehicles were given additional training so that they are constantly on the alert for someone who may walk into the street, against the light, with a headset on.

4.2.4. *New York*

In April 2013, a New York City-based prank done in collaboration with Buzz Feed posed as New York DOT workers providing a solution to the texting and walking epidemic in the city. Half of their team of 60 wore orange vests labeled "I can help you walk and text" on the front and "Seeing Eye Person" on the back. The other half, while attached to the "Seeing Eye Person" by leashes, walked while texting without needing to take their eyes off their phones as shown in Fig. 5 (Nettler, 2013). Later the "Seeing Eye Person" offered the service to real people texting and walking on the street. With real pedestrians, the effort received mixed-up reactions with some grabbing the leash and letting the

Fig. 2 – The "E-Lane" in Philadelphia (NBC10 Philadelphia, 2012).

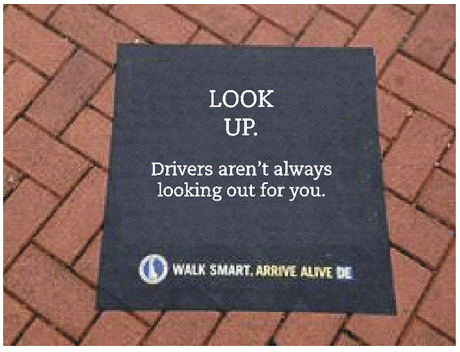

Fig. 3 – Decals in Delaware.

Fig. 4 – Distracted walking street campaign ad in San Francisco.

"Seeing Eye Person" help them cross the street whereas others did not utilize the service. The videos on both settings can be found on the organization website (Nettler, 2013).

4.2.5. *Ontario, Canada*

In August 2012, Toronto police handed out safety pamphlets to distracted walkers. However, no tickets were issued since distracted walking was not illegal in Toronto. In March 2013, in wake of the Ontario Road Safety Annual Report (ORSAR), it was reported that 4522 pedestrian injuries occurred in 2008 year, and of these 598 were directly linked to pedestrian distraction. The Ontario Provincial Police (OPP) launched a "Heads Up," pedestrian safety awareness program to educate students about the dangers of being distracted while walking near traffic (Law, 2013).

4.2.6. *Australia*

In December 2010, the Pedestrian Council of Australia (PCA) launched the "Lambs to the slaughter-wait for the green" pedestrian safety awareness campaign. The concept was developed around the behavior of many pedestrians who often act like sheep when crossing the road, particularly at traffic lights. Many are either listening to iPods & MP3 players, texting or using mobile phones. The campaign thought to highlight the dangers of distracted walking (Fig. 6). The PCA recently launched another pedestrian safety awareness campaign "Don't tune out stop look listen think". This awareness program is also targeted at pedestrians using electronic mobile devices when crossing the road. Further, the New South Wales (NSW) Police said it would support laws banning the use of iPods, mobile phones, and other electronic devices while crossing the road and riding bicycles (PCA, 2012).

4.3. *Walking safety rules/tips*

Preventive strategies for safe walking are essential for reduction of distracted walking problems. Most agencies or organizations and even individuals who promoted walking usually provided safety practices and tips for safe walking, therefore, efforts were made to review some websites. The keyword "safety walking tips" was input into the Google search engine and the first few pages were reviewed. Review results indicated that many states and countries have allied to form organizations to provide information for a targeted audience on walking safely. The Safe Kids Worldwide Organization is an example of the agencies that is originated in the United States, but creates partnerships with other countries. Table 1 lists agencies/organizations and various rules associated with the

Fig. 5 – Seeing eye person.

Fig. 6 – "Lambs to the slaughter – wait for the green" ad in Australia (PCA, 2012).

agency. These agencies/organizations are vital in providing relevant information about safe walking habits that can be pivotal for addressing distracted walking problems.

4.4. *Distracted walking bills*

Web searches on various states and country legislatures were carried out to ascertain states which have distracted walking bills. Acknowledging that distracted walking has become a phenomenon, some states, cities, and countries have attempted to pass distracted walking bills. However, to date none has been successful. In the United States, five states namely Arkansas, Delaware, Illinois, New York, and Utah have unsuccessfully passed distracted walking legislations. In 2011, New York Senator Kruger introduced Bill No. 1945 that would prohibit the use of electronic devices in crosswalks when a city has a population of one million or more. This bill would be applicable to individuals who are holding electronic devices to or near their ear, talking or listening with electronic devices and texting or receiving a message with electronic devices. A person who violates the conditions of the bill would be fined $100. The bill was referred to the Senate's Transportation Committee, but did not see further action (NY Senate, 2013). In 2010, in Arkansas Senator Jeffress withdrew a proposal that would ban pedestrians from wearing headphones in both ears based on 10-1 negative feedback from constituents (Hands Free Information, 2012). In the state of Illinois Representative Ken Dunkin was unsuccessful in proposing a bill in 2008 that would subject crossing the street while using a cell phone to a $25 infraction. In 2012, the Utah legislature declined Utah Transit Authority request to make "distracted walking" around railroads a violation of state law based on 11-4 votes (Davidson, 2012). In Israel, a bill is being submitted to make it illegal to be engaged in SMS texting on the phone while crossing the street (Hands Free Information, 2012). In general, the legislatures in most of the cases focused on headphone use, texting and talking on the cell phone while walking.

5. National Fatality Analysis Reporting System (FARS) data

To identify data availability on distracted walking, this study searched the National Fatality Analysis Reporting System (FARS) for pedestrian fatalities with portable electronic device as a contributing factor (NHTSA, 2014b). FARS is a nationwide (50 States, the District of Columbia, and Puerto Rico) census that provides yearly data on fatal injuries resulting from motor vehicle traffic crashes that occur on the Nation's roadways. Table 2 presents a summary of the four most recent years (2008–2011) of available data from FARS database related to distracted walking. As observed from the table, the number of fatal crashes increased almost every year. Crashes are higher for males compared to females. Of the 11 states with distracted walking crashes the state of California reported more fatal crashes followed by the state of Oregon. As for age, there is nearly a 50% split for those below 34 years of age and those 35 years or more. However, data available from this database is very insufficient to allow

Table 2 – Summary of pedestrian fatal crashes related to portable electronic devices ($n = 23$).

Variable		No.	Percent (%)
Year	2011	9	39.13
	2010	6	26.09
	2009	7	30.43
	2008	1	4.35
Age	15–24	6	26.09
	25–34	6	26.09
	35–44	3	13.05
	≥45	8	34.80
Gender	Male	14	60.87
	Female	9	39.13
State	AZ	2	8.70
	CA	8	34.78
	CT	1	4.35
	KS	1	4.35
	LA	1	4.35
	NY	1	4.35
	OH	1	4.35
	OR	4	17.39
	PA	2	8.70
	RI	1	4.35
	TX	1	4.35

any conclusions to be drawn, but shows that such data are available from state sources. It should be noted that the FARS database only reports fatal injuries. In this vein, there is need of data searches for non-fatal crashes to facilitate analysis which is more logical and conclusive.

6. Summary and conclusions

This study reviewed and examined the state-of-knowledge and state-of-practice of distracted walking on pedestrian safety problems. The issue of distracted walking has become a phenomenon as it has caused fatalities and injuries worldwide. The review results revealed that some transportation agencies and organizations have proposed and/or implemented policies and programs that addressed distracted walking safety related problems. These policies include enforcement (tickets and citations), public awareness programs, and promotion of safe walking rules/tips. The review also suggests a need to collect sufficient crash data to examine and quantify the extent to distracted pedestrian on safety problems to effectively propose countermeasures for the distracted walking quandary. In summary, the study found the following points.

1. Agencies and organizations have been very informative on proper safety walking measures that can be taken to improve safety. Various rules/tips have been given such as not wearing headphones or talking on a cell phone while crossing, keeping the volume down, hanging up the phone while walking, being aware of traffic, avoiding distractions such as walking with texting.
2. Many of the agencies list various safety rules/tips that should be followed while walking, but do not clearly mention the consequences of distracted walking. These agencies could be very vital in getting information across to pedestrians.
3. Existence of various public awareness programs and enforcement demonstrate that problems of distracted walking have started to receive attention. There are two cities, Salt Lake City, Utah and Fort Lee, New Jersey, which have established citations for distracted walking. Many states, cities, and countries have also started public awareness programs. Despite this, there is still greater need for awareness on this problem.
4. The majority of studies reviewed are in agreement with that there is positive correlation between distraction and unsafe walking behavior. For instance, a survey-based study indicated that 25% of the respondents indicated that they believed listening to music while crossing the street was dangerous and unsafe behavior, while most people did not consider this as an issue. Contemplating all the data that has been gathered from the studies, it is evident that distracted walking poses a real safety problem.
5. Experimental-based and observational-based studies clearly showed that distracted walking can have a detrimental safety impact on pedestrians. It was found that texting pedestrians were 3.9 times more prone to exhibit at least one dangerous crossing behavior compared to undistracted pedestrians. The studies dependably signal alarming consequences for distracted pedestrian safety. These studies are pivotal in providing substantial evidence for how harmful distracted walking has become.

7. Recommendations for future research opportunities

Based upon the review presented in this study, there is great demand for more innovations and advancements in understanding how to deal with distracted walking. It is essential to understand that this involves a compilation of efforts that have already been done to determine collaborative efforts to further address problems of distracted walking. In the light of this review, the following is a list of limitations and opportunities for future research directions.

1. There is a need for more quantifiable data that can show how much of a problem distracted walking has become in our society. This can come from more accurate and complete pedestrian crash data information. Research studies that elaborate on what has already been done can be very effective.
2. Expansion of more efficient efforts to alert the public about the dangers of distracted walking and evaluation of their safety effectiveness is an area that is very essential.
3. Further research is needed to characterize which countermeasures are more effective in addressing issues for distracted walking for urban, sub-urban, and rural areas. There have been various public awareness programs and citations implemented for distracted walking. A before and after analysis in the areas that has implemented certain policies could highlight the effectiveness of these policies or strategies on improving safety of distracted pedestrian.

4. In review, the effectiveness of current legislations must be measured in terms of efficiency. By determining what will or will not work will help to form a proper solution for the problem. New innovations and technologies need to be discovered that would be sufficient in combating distracted walking.

The findings of this review highlight the state-of-knowledge and state-of-practice of distracted walking. In this era of rapid technology advances, problems of distracted walking are anticipated to increase in the foreseeable future. To that end, this review would assist different agencies and livable advocates to formulate legislation, awareness programs, and effective countermeasures and evaluate their effectiveness in improving the safety of pedestrians in their communities.

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